Foot-and-Mouth Disease Vaccine

Foot-and-Mouth Disease

Foot-and-mouth disease (FMD) is a severe, highly infectious viral disease of cloven-hooved animals. Although not usually fatal, it causes suffering and vastly reduces animals' commercial value by reducing their weight and milk output. Cattle, swine, sheep, goats, and deer are highly susceptible and can exhibit signs of infection after an incubation period of only 1 to 8 days; however, the incubation period may last longer and in sheep and goats it may go undetected altogether. Clinical signs include fever and blister-like lesions followed by erosions on the tongue and lips; in the mouth, muzzle, and snout; on the teats; between the hooves; and around the digits.

FMD is widely believed to be the most economically devastating livestock disease in the world, and if it were introduced into the United States, which is FMD-free, it could cause billions of dollars in losses to the U.S. economy. Although the disease is not a risk to humans, people who have worked around or been near infected animals can carry and spread the virus via their cars, clothing, shoes, and even through their respiratory tracts.

The FMD Vaccine

Vaccines are used to produce or stimulate immunity against a particular disease. FMD vaccines are killed virus preparations that are pure, safe, and effective, and they are available to the United States through the North American Foot-and-Mouth Vaccine Bank. Mexico and Canada are also members of the Vaccine Bank.

There are seven different types and more than 60 subtypes of FMD virus, and there is no universal vaccine against the disease. Vaccines for FMD must match to the type and subtype present in the affected area. The North American FMD Vaccine Bank stores different types of concentrated, inactivated FMD virus antigen at ultralow temperatures over liquid nitrogen. In this state, several types of antigen can be kept indefinitely and formulated into vaccine rapidly should an FMD outbreak occur.

FMD antigen is produced by first growing the virus in cell cultures; filtering the virus harvest to remove debris; and inactivating it using a chemical such as binary ethyleneimine. The resulting antigen is then concentrated, purified, and stored in a cold, secure holding facility. The North American FMD Vaccine Bank stores several FMD antigens, which are sent overseas when a specific vaccine needs to be formulated. The Bank can obtain hundreds of thousands of doses of FMD vaccine within days. Animals that receive the vaccine usually develop some degree of protection against clinical signs of FMD within 7 to 8 days.

The North American Foot-and-Mouth Disease Vaccine Bank

The North American FMD Vaccine Bank is housed at the Department of Agriculture's (USDA) Foreign Animal Disease Diagnostic Laboratory (FADDL) at Plum Island Animal Disease Center. The Center, located 11/2 miles off the coast of Long Island, New York, is the only place in the United States where scientists can conduct research and diagnostic work on highly contagious exotic animal diseases such as FMD. Currently, the facilities on Plum Island operate at a biosafety-3 level, which indicates that they are designed, constructed, and operated to prevent the escape of microorganisms from the laboratory into the environment.

Scientists at FADDL monitor FMD outbreaks around the world and stock the North American Vaccine Bank with antigens for the most active serotypes or strains of the virus. If necessary, these scientists can isolate and identify an FMD serotype from a field sample in as little as four days. With this information, FADDL scientists would know what vaccine type to order from an overseas supplier, and if it were not in stock, the supplier could use the isolate to create a new vaccine. FADDL scientists also test currently available vaccines. Their testing has helped ensure that FMD vaccines are not contaminated with other microorganisms and that they do not produce adverse local or systemic reactions following administration.

Reasons to Vaccinate

Emergency vaccination can play an important supporting role in the control of FMD outbreaks in FMD-free countries such as the United States. Vaccination can help contain the disease quickly if it is used strategically to create barriers between infected zones and disease-free zones.

If USDA officials were to determine that FMD vaccinations should be administered to U.S. livestock in response to an FMD outbreak, USDA officials would collaborate with State and local officials to determine vaccination zones, and they would work together to inform livestock producers and the general public of the necessary quarantines and vaccination procedures.

Reasons Not to Vaccinate

Although there are FMD vaccines available, they are not currently used in this country because the United States has been free of the disease since 1929. There is no need to vaccinate against a disease that no animals have, especially when strict import restrictions are in place. USDA's Animal and Plant Health Inspection Service (APHIS) imposes import prohibitions on live ruminants and swine and their products on all FMD-affected countries. In response to the FMD outbreak among some European Union (EU) member countries in early 2001, APHIS has temporarily restricted the importation of live ruminants and swine and their products from all EU member states. If an outbreak occurred here, USDA's first response would be to take swift measures to contain and eradicate the disease.

USDA has several reservations about implementing a vaccination program. First, for animals to maintain immunity to FMD, annual re-vaccination is required. This would be a costly investment and would require considerable effort on the part of animal health technicians, producers, veterinarians, and others involved in the livestock industry. There is also a risk of the disease spreading outside of vaccination zones. For example, vaccine teams could carry the virus from an infected farm to a clean farm if they do not follow proper sanitary procedures. In addition, once the vaccination program starts, the United States might be lulled into a false sense of security. The vaccine does not protect animals against FMD infection; it is designed to protect animals from developing the clinical symptoms of the disease. This means that if a vaccinated animal encountered the disease in circulation, the animal could harbor the virus for several months or years in its upper respiratory tract. Members of the public who do not realize this might allow vaccinated animals to come into contact with unvaccinated animals, including deer and other wildlife, and the vaccinated animals may spread the disease.

Finally, if an FMD vaccination program were implemented in the United States, our country's international trade status would be compromised. Countries that vaccinate for FMD cannot claim FMD-free status, so U.S. livestock exports would face many new restrictions. This could cost U.S. producers millions, if not billions, of dollars. The Office International des Epizooties' current International Animal Health Code requires FMD-free countries such as the United States to undergo a 3-month waiting period between the time they have slaughtered their last vaccinated animals and the time they can claim FMD-free status, assuming ongoing surveillance and serological testing have demonstrated the country's freedom from FMD viral activity. In the event that vast numbers of animals were to be vaccinated or if re-vaccinations were needed, our country could wait years before regaining FMD-free status.

Summary

USDA currently maintains a variety of FMD antigens, which could be swiftly finished and deployed as vaccine if officials determined this to be an appropriate response to an FMD outbreak. There are drawbacks to using the vaccine, including its potentially devastating impact on export markets, so USDA's first response to an outbreak would be one of "stamping out"—freezing animal movement and eradicating the disease immediately.

USDA scientists at Plum Island Animal Disease Center continue to develop and experiment with novel biotechnology to improve the FMD vaccine.

Additional Information

For more information about the FMD vaccine, contact:

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